LABORATORIES THAT MAKE FIRE ASSAYS, ANALYSES, AND TESTS OF ORES, MINERALS, METALS, AND OTHER INORGANIC SUBSTANCES

BY B. R. KLAHOLD

* * * * * * * * * * Information Circular 7695

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary
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J. J. Forbes, Director

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by

B. R. Klahold[1/]

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1/ Librarian, Bureau of Mines, College Park, Md.

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INTRODUCTION

Each year hundreds of mineral specimens and numerous inquiries regarding tests and analyses of minerals and related inorganic substances are received by the Bureau of Mines. In response to this demand, in years past Information Circulars were published containing a list of laboratories. This paper is a revised version of Information Circular 7523. The listing has been changed from a regional basis to one of States arranged alphabetically and grouped by cities, again alphabetically, with Alaska and Canada listed at the end. All the services given at these laboratories are listed on one page for convenience and brevity.

This list is compiled as a public service, and none of the laboratories listed herein are recommended over any other nor can the Bureau of Mines vouch for their results.

ACKNOWLEDGMENT

Questionnaires were sent to organizations whose work is connected with mineral and metallurgical testing. The response, in general, was satisfactory, and the author takes this opportunity to express her appreciation to the officers of the laboratories listed for their cooperation.

FEDERAL AND STATE AGENCIES

Many mineral samples are sent to Government agencies with the request that they be assayed or chemically analyzed. It should be emphasized that there is no place in Washington, D. C., or elsewhere where assays and quantitative analyses are made for the public by the Federal Government.

Virtually all of the States maintain a bureau of mines, a geological survey, or some similar organization, frequently at the State university, where minerals found by residents of the State will be identified free of charge. Usually, a charge is made for assays. Specific tests, as on clays, are made by some of these offices.

The Federal Bureau of Mines, although it attempts to avoid duplication of services rendered by State bureaus, is always glad to give advice as to prospective markets. It does not compete with private assayers and chemists, but with respect to samples sent to its field laboratories, it does offer to identify them as far as this can be done by inspection and optical and qualitative chemical tests. This examination is usually sufficient to indicate whether the material has commercial value, or at least if the expense of an assay would be warranted. Except in connection with its own technical investigations, no assays or other special tests are made by the Bureau of Mines.

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The Federal Geological Survey and the National Museum also make simple tests of specimens as a public service. Neither of these bureaus nor the Bureau of Mines, however, renders such services on long suites of specimens submitted by mineral dealers, well drillers, or others, when such work can be done regularly by commercial concerns.

The National Bureau of Standards likewise does not make assays or analyses for the general public. A Bureau of Standards publication[2/] gives a detailed list of the testing firms and college research laboratories throughout the United States. Under the Geographical Listing of Colleges will be found each special laboratory and the name of the man in charge. For this reason, few college laboratories are given in the Bureau of Mines list.

Assays and analyses of ores for gold, silver, copper, lead, and zinc are made by the Bureau of the Mint at the United States Assay Office, Seattle, Wash. Gold and silver bullion and jewelry free from platinum-group metals are assayed by the Bureau of the Mint at the Assay Offices in Seattle, Wash., and New York, N.Y., and at the mints in Philadelphia, Pa., San Francisco, Calif., and Denver, Colo. Assays of platinum, palladium, and iridium metals, except in samples of ores, slags, or mattes, may be made at the assay office at New York when authorized by the Director of the Mint. A charge is made for each metal determined.

TERRITORIES

The Territorial Department of Mines (under the Office of the Commissioner of Mines) operates four assay offices in Alaska. These are listed under Alaska, which follows the listing of States. Assays and analyses are made without charge to Alaskan prospectors and to mining companies engaged in mine development. Operating companies are charged for work at commercial rates.

The Federal Bureau of Mines has complete laboratory facilities at Juneau, Alaska. However, no commercial work is accepted.

FOREIGN AGENCIES

The Department of Mines and Resources, Ottawa, Canada, identifies Canadian minerals free of charge and makes certain assays and analyses for a fee. The laboratories of the Provincial Governments also are available for these services.

The address of the Government laboratory in Mexico is Unidad Experimental de Tecamacholco de la Comision de Fomento Minero Loma de Chapultepec, Apartado Postal 10505, Mexico, D. F. In addition to free identifications, this laboratory makes fire assays for gold, silver, platinum, tin, and lead, and performs quanitative analyses of minerals, ores, ceramic products (clays, feldspar, refractories, bauxite, sand, abrasives, pigments), metals, and fluxes. A laboratory is maintained for ore-dressing and metallurgical tests, and a service is provided for weighing, sampling, and umpire analysis of ore shipments for export and import. Prices charged for these services are very low to encourage development of the mineral industry.

2/ Bureau of Standards, Directory of Commercial Testing, and College Research Laboratories: Misc. Pub. M 187, 1947.

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PROCEDURE FOR OBTAINING SAMPLES

The economic exploitation of a mineral deposit follows a more or less set sequence. Invariably the first step is identification to determine whether the ore to be mined or the mineral to be sold is actually what it is thought to be. An identification is a qualitative examination designed to give information as to what a substance may be rather than how much of it may be present.

If the identification shows the material to be one of possible commercial value, the next step is to take a sample representative of the exposed face or outcrop for assay or quantitative chemical analysis. Preliminary consideration also should be given to certain economic aspects. For example, no mineral deposit, irrespective of its size and grade, is of immediate value if it is so inaccessible that the product cannot be mined, processed, transported, and sold at a profit on a competitive market.

Directions for obtaining a sample are well described in an instruction sheet issued by the Department of Mines, Quebec, Canada, as follows:

> Sampling should always be made on a fresh surface. There are two ways of proceeding, of which the second is the more reliable.
>
> First method: With a hammer, knock off chips of approximately equal size at regular intervals over the whole width of the mineral occurrence.
>
> Second method: Draw two parallel lines three inches apart, marking the width to be sampled, and with a cold chisel, or a moil of tempered steel cut out a groove, half an inch or so in depth, for the whole length between the two lines; the material thus chiselled out will constitute the sample. It is very important to carefully collect the whole of the detached material, both chips and dust, on a sheet of canvas, strong cotton or cloth.
>
> A sample thus obtained will be fairly representative of the mineralization at the place where it was taken. In order to make an estimate of the value of a mineral deposit, it will be necessary to repeat the sampling process at regular intervals, say every 20 feet, and at the same time taking note of the location and of the length of the grooves thus made. Bag and number each sample separately.

If the analyses of samples taken in this manner show promise, the succeeding steps in the procedure are (1) a thorough sampling of the deposit to determine grade and tonnage available, (2) beneficiation or smelting tests, (3) a marketing survey, and (4) consideration of such engineering factors as mining methods, design of concentration or treatment plant, water and power supply, and estimates of costs.

These operations are usually difficult and expensive and should be carried out under the guidance of trained engineers. The development of a prospect from the original discovery to a producing mine is a major undertaking that requires considerable capital and experience.

Advice as to how to proceed with a project may be obtained from a number of sources. Advice of a general sort, requiring no field work or laboratory testing,

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can be obtained from the Bureau of Mines. For projects where a paid, professional consultant is needed, names and addresses may be found in the advertising sections of appropriate trade journals. The Directory of Members of the American Institute of Mining and Metallurgical Engineers, 29 West 39th Street, New York 18, N. Y., lists the names and addresses of mining engineers and metallurgists available for consulting work. For names of consultants specializing in metallurgical and chemical problems, a useful source is the classified directory of the Association of Consulting Chemists & Chemical Engineers, 50 East 41st Street, New York, N. Y. Another useful directory is the volume entitled "Industrial Reserach Laboratories of the United States", published by the National Research Council, 2101 Constitution Avenue, Washington, D. C.

DESCRIPTION OF TESTING TECHNIQUES

Various testing techniques are made available by commercial laboratories, the choice of which depends on the problem to be solved. The respective techniques are described below for the benefit of those who may not be familiar with this information.

Chemical Analysis

A chemical analysis is used for the bulk of laboratory testing to determine how much of a particular element is present in a sample. A chemical analysis may also be merely qualitative, but the older qualitative tests, including blowpipe analysis, are rapidly being replaced by spectrographic and spectroscopic examinations. The value of a quantitative analyses depends on how representative the sample is of the total bulk of material to be tested. For example, no ore or mineral deposit is uniform throughout; consequently, analysis of a sample consisting of a specimen or a few randomly chosen pieces of rock is useless in attempting to evaluate the deposit from which they are taken. This information can be obtained only by prescribed scientific methods of sampling.

Fire Assaying

This process consists of fusing the sample with lead oxide and a reducing agent in a crucible. The precious metals, gold, silver and platinum, are collected in the lead. The mass of lead is then removed by oxidation and absorption in bone ash, leaving a bead of precious metal to be weighed. Fire assaying is the common method of making determinations for the three metals mentioned. It can also be used for lead and tin, although wet methods have now virtually supplanted fire assaying for these two metals.

Spectrographic Analysis

This technique of qualitative and quantitative analysis consists of producing, recording, and measuring the optical emission spectra of the elements in samples using electrical excitation and highly specialized optical equipment. Each element has an unique emission spectra in the visible and ultra-violet wavelength regions usually used. Infrared spectra, both emission and absorption, are used to identify certain elements and many organic compounds. Fluorescent X-ray spectrographic equipment has recently been developed for quantitative analysis by using the characteristic X-ray emission spectra of elements.

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Microscopic Examinations

Several distinct applications of the microscope are used in the mining and metallurgical field. The sulfides and other opaque minerals are generally mounted in a plastic medium such as bakelite or lucite, polished on a revolving wheel, and examined with a metallographic microscope. In this way it is usually possible to determine the minerals that compose the sample, whether the masses of the various minerals are large or small, well separated or intergrown, how much grinding will be necessary to liberate the masses for subsequent concentration, and other questions regarding the physical state of the sample.

The transparent minerals are examined in thin sections or as crushed grains on a glass slide, with index mediums, by the petrographic microscope. The optical properties of these minerals are thereby determined and used for their identification and evaluation.

Metals and alloys are mounted similarly to the opaque minerals and are examined by the metallographic microscope to determine the size and shape of the grains, the identity of the alloys formed, the effect of heat treatment upon the physical structure of the metals, and the nature and location of inclusions.

The electron microscope is an electronic apparatus in which a specially prepared sample is exposed to an electron beam, which is then made to form a greatly enlarged image of the sample on a photographic film or fluorescent screen. The technique shows the size and shape of particles transparent to an electron beam far smaller than those visible in ordinary-light microscopes.

X-Ray Diffraction Analysis

This involves various techniques in which solid or powdered samples are exposed to an X-ray beam, and the rays that are diffracted from the crystals within the sample are recorded and measured. By these means it is possible to identify the minerals and to distinguish between those having the same chemical composition but different crystal structure. It is also possible to estimate the average size of particles in a very finely divided powder in the range below that handled by microscopes.

Radioassays

Several methods of analysis based on the measurement of radioactivity are now being utilized successfully. Radioactivity isotopic tracer techniques are used for special types of analyses difficult or impossible to perform by other methods. So-called radiometric analyses are analytical procedures by tracer methods for elements that are themselves not radioactive, that is, precipitation of silver iodide with radioactive iodine. Methods of precise measurement of natural radioactivity of mineral and ore samples are a means of determining their uranium, thorium, radium, potassium, etc content.

Ore Beneficiation

The mined product from many mineral deposits cannot be marketed without some concentration or cleaning to remove impurities. Such treatment is commonly called beneficiation. There are concerns having the necessary mechanical equipment and experience that make small-scale beneficiation tests on lots of ore weighing from about 50 pounds to 1 ton or so. From results of such tests, the most suitable method of treatment can be determined, and an estimate can be made of such factors

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as degree of beneficiation and costs of operation. Another use of small-scale beneficiation tests is to produce enough of the finished product to submit as trial samples to possible consumers.

Physical Testing

The physical properties of minerals and mineral products are often important in determining their value to industry. Color, plasticity, refractoriness, melting point, density, porosity, hardness, and other physical properties are determined by specific tests, which are numerous and specialized, depending on the use for which the product is intended.

PRICES AND FEES

The trade generally recognizes three qualities of work. The first and lowest priced analysis is designated by such terms as routine, engineer's survey, preliminary, etc. A higher priced, more careful, analysis is called control, and the third and most expensive is called umpire. Unfortunately, there is no way to setting up standards of quality on the basis of accuracy, because some elements, such as iron or copper, can be determined in the usual samples with little effort to a high degree of accuracy, whereas others require time-consuming procedures and great skill, in spite of which accuracy of results is only fair.

The prices listed are in effect as of April 1, 1954; they are for single samples. Discounts are usually granted if many samples of the same type are submitted at one time.

Fire assay:

Gold	$1.50 to $ 5.00
Silver	1.00 to 3.00
Gold and silver	2.00 to 7.50
Platinum	3.00 to 10.00
Platinum group	15.00 to 30.00

Higher prices are charged for the assay of the richer samples, such as bullion, sweepings, jewelry, etc.

The common elements in ores and the standard alloys, iron, copper, lead, zinc, tin, silica, alumina, antimony, arsenic, sulfur, chromium, manganese, phosphorus, calcium, magnesium, etc. .....$2 to $8.

Medium priced group, soda, cobalt, nickel, bismuth, cadmium, uranium, molybdenum, titanium, etc. .....$7 to $15.

Higher priced group, beryllium, boron, cerium, fluorine, columbium, tantalum, strontium, selenium, thallium, gallium, germanium, indium, thorium, lithium, etc. .....$8 to 50.

Control and umpire analyses, two to three times the price of routine analyses.

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	Dollars		
Limestone analysis	25	and up	
Clay analysis	15	to 25	
Spectrographic analysis (complete qualitative)	7	to 25	
X-ray diffraction	15	to 50	
Petrographic examination	15	to 50	
Metallographic examination	5	to 20	per hour
Flotation tests	60	and up	or
	30	to 40	per day, per man.
Physical tests (cement, concrete, metals)	6.50	to 10	per hour
Weighing and sampling	25	to 50	per day
Magnetic separation	7.50	per hour	
Firing and behavior of clays	75		

The following list of laboratories is arranged alphabetically by States and cities.

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Laboratory names and addresses	Chem. analyses, nonmetallic	Metallic	Metals/alloys nonferrous	Ferrous	Fire assays, gold-silver	Platinum	Miscellaneous	Spectrographic analyses	Petrographic evaluation	X-ray diffraction	Metallographic analyses	Ore testing, beneficiation	Weighing-sampling, umpire analyses	Electron microscopy	Physical testing	Metallic materials	Ceramics	Miscellaneous
ALABAMA																		
Picard Testing Laboratories, Inc. 2920 Seventh Ave., South, P.O. Box 1231, Birmingham 1.....	X	X	X	X											X	X		
ARIZONA																		
E. Ross Housholder Laboratory, 431 East Spring St., Kingman....		X			X							X	X					
Miller's Assay Office, 233 Grand Ave., Nogales.....		X	X		X	X												
Arizona Assay Office, 815 North First St., P.O. Box 1148, Phoenix.....	X	X	X	X	X	X						X	X					
Arizona Testing Laboratories, 817 West Madison Ave., Phoenix.....	X	X	X	X	X	X		X				X	X		X			
ARKANSAS																		
Van Trump Testing Laboratory, 219 Terminal Warehouse Bldg., Little Rock.....	X	X	X	X			1/X					X	X		X	X	X	
CALIFORNIA																		
C. M. Ball, 911 University Ave., Berkeley 2.....	X	X	X		X	X						X						
Quality Control Laboratory, 12232 East Valley Blvd., El Monte.....	X	X	X	X	X	X		X			X		X		X			
Twining Laboratories, 2527 Fresno St., Fresno.....	X	X	X	X	X	X		X		X	X	X	X		X	X	X	2/I
Hollywood Testing Laboratories, 1257 North La Brea Ave., Hollywood 38.....	X	X	X	X	X	X	3/X	X	X	X	X	X	X	X	X	X	X	
California Testing Laboratories, Inc., 619 East Washington Blvd., Los Angeles 15.....	X	X	X	X	X			X			X		X		X	X	X	4/I
Kennard and Drake, 3364 East 14th St., Los Angeles 23.....	X	X		X							X		X		X	X		
Los Angeles Testing Laboratory, 1300 South Los Angeles St., Los Angeles 15.....	X	X	X	X	X	X		X			X	X	X		X	X	X	
Minerals Engineering Co., 417 South Hill St., Los Angeles 13..	X	X			X			X										
Raymond G. Osborne Laboratories, 110 West 9th St., Los Angeles 15.....	X	X	X	X				X		X		X			X			5/I
Harley A. Sill, 1011 South Figueroa St., Los Angeles 15....	X	X	X	X	X	X	6/X		X			X	X		X	X		

1/ Bauxite, titanium, manganese.
2/ Concrete.
3/ Tantalum, columbium.
4/ Concrete testing, inspection.
5/ Concrete, steel building materials.
6/ All inorganic minerals.

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Laboratory names and addresses	Chem. analyses, nonmetallic	Metallic	Metals/alloys nonferrous	Ferrous	Fire assays, gold-silver	Platinum	Miscellaneous	Spectrographic analyses	Petrographic evaluation	X-ray diffraction	Metallographic analyses	Ore testing, beneficiation	Weighing-sampling, umpire analyses	Electron microscopy	Physical testing	Metallic materials	Ceramics	Miscellaneous
CALIFORNIA (Con.)																		
Smith-Emery Co., 781 Washington Blvd., Los Angeles 21.....	X	X	X	X	X	X		X	X		X		X		X	X	X	
United States Testing Co., Inc., 1723 South Maple Ave., Los Angeles 15. See: Hoboken, N.J.																		
Harold Scheave Custom Assay Office, 232 Commercial St., Nevada City.		X	X	X	X	X							X					
A. J. Hales and Co., Inc., 4514 Hollis St., Oakland 8.....			X	X							X				X	X		1/X
Morse Laboratories, 316 16th St., Sacramento 14.....	X	X	X	X	X	X		X				X	X		X			2/X
Curtis and Tompkins, Ltd., 236 Front St., San Francisco 11.....	X	X	X	X									X					
Abbot A. Hanks, Inc., 624 Sacramento St., San Francisco 11.....	X	X	X	X	X	X		X					X		X	X		3/X
Metallurgical Laboratories, 604 Mission St., San Francisco 5....	X	X	X	X									X		X	X		
Pittsburgh Testing Laboratory, 651 Howard St., San Francisco 5.	X	X	X	X	X	X		X			X		X		X	X		
Western Gold & Platinum Works, 589 Bryant St., San Francisco 7.					X	X												
National Supply Co., 1524 Border Ave., Torrance.....			X	X							X				X	X		
COLORADO																		
Oscar N. Bribach, 800 Dayton St., Aurora Branch: 1439 Blake St., Denver 2.....	X	X	X		X	X		X				X	X					
Colorado Assaying Co., 2013 Welton St., Denver 1.....	X	X	X	X	X	X		X										
Denver Equipment Co., 1755 Blake St., Denver.....												X						4/X
Charles O. Parker & Co., 2114 Curtis St., Denver 2.....	X	X	X	X	X	X			X			X	X					
Root & Simpson, Inc., P.O. Box 2069, Denver 1.....	X	X			X	X							X					
United States Testing Co., Inc., 4939 Lafayette St., Denver See: Hoboken, N. J.																		
The Henry E. Wood Assaying Co., 2042 Broadway, Denver 2.....		X	X		X	X							X					

1/ Building materials.
2/ Building materials, concrete.
3/ Concrete, soils, aggregate tests.
4/ Flotation testing, cyanide, grinding, and leaching.

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CONNECTICUT																		
Bridgeport Testing Laboratory, 14 Willow St., Bridgeport 10....	X	X	X	X				X			X		X		X	X		1/x
State Testing Laboratory, 319 East Main St., Bridgeport.....		X	X	X				X			X	X			X			2/x
Horace J. Hallowell, 323 Main St., Danbury.....	X	X	X	X									X					
The Henry Souther Engineering Co., 11 Laurel St., Hartford 6.....			X	X				X			X				X	X		
The Dorr Co., Westport Mill Research & Testing Labs., Westport.....	X	X	X	X	X							X						
DISTRICT OF COLUMBIA																		
Bjorksten Research Laboratories, Inc. 412 Fifth St., N.W., Washington 1, D. C.									X			X						
Froehling and Robertson, Inc., 1503 Wisconsin Ave., N.W., Washington, D. C.	X	X	X	X					X	X	X		X		X	X	X	
DELAWARE																		
Lehigh Testing Laboratories, P.O. Box 1241, Wilmington.....	X	X	X	X	X			X			X				X	X		
GEORGIA																		
Law & Co., Inc., 136 Forrest Ave. N.E., P.O. Box 1558, Atlanta....	X	X	X	X									X					
IDAHO																		
Adelmann Bros. Assay Office, 622 Idaho St., Boise.....		X			X	X				X		X	X	X	X			
ILLINOIS																		
Accurate Metal Laboratories, 2454 West 38th St., Chicago 32.....			X	X				X										
Bjorksten Research Laboratories, Inc., 1525 East 53rd St., Chicago, 15.....									X			X						
Chicago Spectro Service Laboratory, Inc., 2454 West 38th St., Chicago 32.....	X	X	X	X				X					X					
Robert W. Hunt Co., 175 West Jackson Blvd., Chicago 4.....	X	X	X	X	X	X					X		X		X	X	X	3/x
International Testing Laboratories, Inc., 407 S. Dearborn St., Chicago. See: Newark, N. J.																		

1/ Radiography.
2/ Concrete X-ray exam, salt spray test.
3/ Rubber.

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ILLINOIS (Con.)																		
Charles C. Kawin Co., 431 South Dearborn St., Chicago 5.....			X	X				X			X				X	X		
Scientific Control Laboratories, 600 Blue Island Ave., Chicago 7.	X	X									X		X		X	X		1/X
Spectro-Chemical Research Laboratories, Inc., 3303-3313 West Lawrence Ave., Chicago 25.....	X	X	X	X	X	X	2/X	X				X	X		X	X		
United States Testing Co., Inc., 325 W. Huron St., Chicago See: Hoboken, N. J.																		
Van Trump Testing Lab., 329 South Wood St., Chicago 12.....	X	X	X	X			3/X					X	X		X	X	X	
George A. Hale, 3850 Foster St., Evanston.....	X	X	X	X	X	X		X				X	X		X			4/X
INDIANA																		
Frederick C. Atkinson, Inc., 211 East South St., Indianapolis 25.	X		X	X														
IOWA																		
Patzig Testing Laboratories, 2215 Ingersoll Ave., Des Moines 12...	X	X	X	X	X			X			X	X	X		X	X	X	
KENTUCKY																		
Janes & Geiger, Inc., 817 West Market St., Louisville 2.....	X	X	X	X									X					
LOUISIANA																		
Harold A. Levey Laboratories, 8127-33 Oleander St., New Orleans 18.	X	X	X	X								X	X		X	X		
Shilstone Testing Laboratory, 814 Conti St., New Orleans.....	X	X	X	X				X			X		X		X			5/X
MAINE																		
A. B. Andrews, Lewiston.....	X	X	X	X				X							X	X		
MARYLAND																		
R. C. Crippen Research & Development Labs., 1138 East North Ave. Baltimore 2.....	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	6/X
Froehling & Robertson, Inc., 120 East Center St., Baltimore Branch: See Richmond, Va.																		
Penniman & Browne, Inc., 341 St. Paul Pl., Baltimore 2.....	X	X	X	X	X	X	7/X	X	X	X	X	X	X		X	X	X	8/X

1/ Corrosion, paints, plastics.
2/ Any metal.
3/ Bauxite, titanium, manganese.
4/ Nonmetallic.
5/ Concrete, steel.
6/ Coals, fuels.
7/ Lead.
8/ Soils, building materials.

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Laboratory names and addresses	Chem. analyses, nonmetallic	Metallic	Metals/alloys nonferrous	Ferrous	Fire assays, gold-silver	Platinum	Miscellaneous	Spectrographic analyses	Petrographic evaluation	X-ray diffraction	Metallographic analyses	Ore testing, beneficiation	Weighing-sampling, umpire analyses	Electron microscopy	Physical testing	Metallic materials	Ceramics	Miscellaneous
MARYLAND (Con.)																		
Strasburger & Siegel, 1403 Eutaw Pl., Baltimore 17.....	X	X	X	X							X							
MASSACHUSETTS																		
Attleboro Refining Co., 100 Union St., Attleboro.....					X													
Metal Hydrides, Inc., 12-24 Congress St., Beverly.....		X	X					X										
Eastern Smelting & Refining Corp. 109 West Brookline St., Boston 18.....	X	X	X		X	X	1/X					X	X					
Skinner & Sherman, Inc., 246 Stuart St., Boston 16.....	X	X	X	X				X			X		X		X	X	X	
United States Testing Co., 857 Boylston St., Boston See: Hoboken, N. J.																		
The Thompson & Lichtner Co., Inc. 8 Alton Pl., Brookline 46.....	X	X	X	X	X						X				X	X	X	2/X
New England Spectrochemical Laboratories, County Road, Ipswich.	X	X	X	X				X		X	X		X		X		X	3/X
George P. Swift Electro & Spectrochem. Labs., 53 Galen St., Watertown 72.....								X										
J. Dirats & Co., Inc., Notre Dame St., Westfield.....			X	X				X										
MICHIGAN																		
Detroit Testing Laboratory, 554 Bagley Ave., Detroit 26.....	X	X	X	X				X			X		X		X	X	X	4/X
MINNESOTA																		
Lerch Brothers, P.O. Box 810, Hibbing.....		X		X								X	X					
Van Cleve Laboratories, Inc., 322 South 4th St., Minneapolis 15...	X		X		X	X	-											
Twin City Testing & Engineering Laboratory, 2440 Franklin Ave., St. Paul 14.....	X	X	X	X							X		X		X			
MISSOURI																		
Millar Chemical Laboratory, 617-1/2 Joplin St., Joplin.....	X	X	X	X														
Bruce Williams Laboratories, 618-624 Joplin St., Box 557, Joplin.	X	X	X	X	X	X		X				X	X		X	X		

1/ Palladium.
2/ Construction materials.
3/ Paper, textiles.
4/ Concrete, brick.

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MISSOURI (Con.)																		
Cross Laboratories, Inc., 700 Baltimore Ave., Kansas City 5...	X	X	X	X	X	X									X	X	X	
General Testing Laboratories, 1519 Walnut St., Kansas City 8.....	X	X	X	X									X		X	X	X	
Missouri Clay Testing & Research Laboratories, Rolla.....	1/X							X	X	X					X		X	
George A. Hale, 3264 January Ave., St. Louis 9.....	X	X	X	X	X	X		X				X	X		X			2/X
Industrial Research & Testing Laboratories, 1919 Chouteau Ave., St. Louis 3.....	X	X	X	X				X		X			X		X	X	X	
St. Louis Testing Laboratory, Inc., 2317 Chouteau Ave., St. Louis 3.	X	X	X	X			3/X					X	X			X	X	4/X
MONTANA																		
Lewis & Walker, 108 North Wyoming St., Butte.....	X	X	X	X	X	X							X					
Goodall Bros., 46 South Main St., Box 537, Helena.....		X			X	X												
Montana Laboratory Co., P.O. Box K Philipsburg.....	X	X	X	X	X	X												
NEBRASKA																		
Harris Laboratories, 816 P. Street Lincoln 8.....	X	X	X	X				X										
Omaha Testing Laboratories, 511 South 20th St., Omaha 2.....	X	X	X	X											X	X	X	
NEW JERSEY																		
Standard Testing Laboratories, Inc. 309 Cortlandt St., Belleville 9.	X	X	X	X	X	X							X					
United States Testing Co., Inc., 1415 Park Ave., Hoboken.....	X	X	X	X	X	X	5/X	X	X	X	X	X		X	X			
New Jersey Ceramic Research Station Rutgers University, New Brunswick.....								X	X	X					X		X	
International Testing Laboratories, Inc., 578-582 Market St., Newark 5.....	X	X	X	X	X	6/X		X			X		X		X	X	X	
Shields Refining Co., 10 Delancey St., Newark 5.....		X	X		X	X						X	X		X	X		
Roy C. Migliorino, 489 East 22d St., Paterson 4.....	X	X	X	X					X			X						

1/ Clays.
2/ Nonmetallic.
3/ Fire-assay, brass scrap.
4/ Photomicrography.
5/ Precious metal alloys.
6/ All precious metals, palladium, iridum, etc.

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NEW JERSEY (Con.)																		
Ledoux & Co., Inc., 359 Alfred Ave., Teaneck	X	X	X	X	X	X	1/X	X					X					
NEW MEXICO																		
Ira L. Wright, Box 231, Silver City	X	X	X	X	X	X												
NEW YORK																		
Buffalo Testing Laboratories, Inc., 37 Niagara St., Buffalo 2	X	X	X	X	X	X					X		X		X	X		
Hallenbeck Testing Laboratory, 52 Pearl St., Buffalo 2			X	X									X		X			2/X
Charles C. Kawin Co., P.O. Box 2035 Buffalo 5. Branch: 431 S. Dearborn St., Chicago			X	X				X			X				X	X		
Williams Gold Refining Co., 2978 Main St., Buffalo 14		X	X		X	X							X		X	X		
John H. Banks Laboratories, Inc., 106 Water St., New York 5	X	X	X	X	X	X							X					
Bjorksten Research Laboratories, Inc., 50 East 41st St., New York 17									X			X						
City Testing and Research Laboratories, Inc., 250 West 54th St., New York 19	X	X	X	X							X		X		X	X	X	
Robert Kann, 106 Water St., New York 5	X	X	X	X	X								X		X	X		3/X
New York Testing Laboratories, 74-80 Washington St., New York 6	X	X	X	X	X	X		X			X	X	X		X	X	X	
Lucius Pitkin, Inc., 47 Fulton St. New York 38	X	X	X	X	X	X		X	X	X	X	X	X		X	X		
Public Service Testing Laboratories, Inc., 137-139 East 25th St., New York 10	X	X	X	X								X	X		X	X		
Stillman & Van Siclen, Inc., 106 Water St., New York 5	X	X	X	X	X			X				X	X					
Stillwell & Gladding, Inc., 130 Cedar St., New York 6	X	X	X	X														
Sam Tour & Co., Inc., 44 Trinity Place, New York 6	X	X	X	X	X		4/X	X	X	X	X	X	X		X			5/X
United States Testing Co., Inc., 330 West 42d St., New York See: Hoboken, N. J.																		

1/ All precious metals.
2/ Concrete, earth and rock borings.
3/ Inspection of shipments of metal scrap.
4/ Titanium.
5/ Corrosion testing, radiography.

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NEW YORK (Con.)																		
Walker & White, Inc., 409 Pearl St., New York 38		X	X	X	X	X							X					
Polytechnique Laboratories, 13049 Lefferts Blvd., Ozone Park 16	X	X	X	X	X	X							X					
Metalloy Chemical Laboratory, 22 Glasgow St., Rochester 8			X	X														
National Testing Laboratories, Inc., 135 University Ave., Rochester 2			X	X														
NORTH CAROLINA																		
Froehling & Robertson, Inc., 430 South Brevard, Charlotte Branch: See Richmond, Va.																		
Carolina Pyrophyllite Co., P.O. Box 2414, Greensboro	X											X			X		X	
V. Claiborne Kilby, Milton	X	X	X	X	X													
Froehling & Robertson, Inc., 135 East Morgan, Raleigh Branch: See Richmond, Va.																		
Law and Co., P.O. Box 629, Wilmington	X	X	X	X									X					
OHIO																		
Wadsworth Testing Laboratory, P.O. Box 208, Canton 1	X	X	X	X							X		X		X	X		
Analytical Chemists of Cincinnati, 4 West 7th St., Cincinnati 2	X	X	X	X									X					
F. C. Broeman & Co., 1926 Race St. Cincinnati 10	X	X	X	X									X		X	X		
H. C. Nutting Co., 4120 Airport Rd., Cincinnati 26		X	X	X											X	X		1/X
Cremer-Case Co., 1200 West 9th St., Cleveland 13							2/X						X					
Crowell & Murray, Inc., 806 Perry-Payne Bldg., Cleveland 13	X	X											X					
James H. Herron Co., 1360 West Third St., Cleveland 13	X	X	X	X				X			X		X		X	X		
Horizons, Inc., 2891-2905 East 79th St., Cleveland 4									X	X	X	X			X	X	X	
National Spectrographic Laboratories, Inc., 6300 Euclid Ave., Cleveland 3	X	X	X	X	X	X	3/X	X		X	X		X					

1/ Building materials.
2/ Sample iron cargoes.
3/ Lead and tin.

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Laboratory names and addresses	Chem. analyses, nonmetallic	Metallic	Metals/alloys nonferrous	Ferrous	Fire assays, gold-silver	Platinum	Miscellaneous	Spectrographic analyses	Petrographic evaluation	X-ray diffraction	Metallographic analyses	Ore testing, beneficiation	Weighing-sampling, umpire analyses	Electron microscopy	Physical testing	Metallic materials	Ceramics	Miscellaneous
OHIO (Con.)																		
Textor Laboratories, 1627 East 25th St., Cleveland 14.....	X	X	X	X	X	X							X					
Bowser-Morner Testing Laboratories, 141 Bruen St., P.O. Box 51, Dayton 1.....	X	X	X	X							X				X	X		
Sharp-Schurtz Co., Lancaster.....	X																X	
OKLAHOMA																		
Oklahoma Testing Laboratories, 310 North Klein St., P.O. Drawer 3838, Oklahoma City.....	X	X	X	X							X				X	X		
Picher Assay Office, Picher.....	1/X												1/X					
Tulsa Testing Laboratory, P.O. Box 1046, Tulsa.....	X	X	X	X					X		X				X	X		
OREGON																		
Charlton Laboratories, Inc., P.O. Box 1048, Portland 7.....	X	X	X	X				X			X				X			2/X
Northwest Testing Laboratories, 3828 North Mississippi Ave., Portland 12.....	X	X	X	X														
Oregon State Dept. of Geology and Mineral Industries, 1069 State Office Bldg., Portland 1.....	X	X	X	X	X	X		X	X									
Pittsburgh Testing Laboratory, 2419 S.E. Powell Blvd., Portland 2.....	X	X	X	X	X	X		X	X		X	X	X		X	X	X	
PENNSYLVANIA																		
Andrew S. McCreath & Son, 236-242 Liberty St., Harrisburg.....	X	X	X	X	X	X		X	X	X		X	X					3/X
J. Bishop & Co. Platinum Works, Malvern.....			X			X												
W. B. Coleman & Co., 9th St. and Rising Sun Ave., Philadelphia 40.....		X	X	X				X			X		X		X	X		
Empire Smelting & Refining Co., 718 Sansom St., Philadelphia 6..		X	X		X	X												
T. B. Hagstoz & Son, 709 Sansom St., Philadelphia 6.....	X	X			X	X	4/X											
International Testing Laboratories; Inc., P.O. Box 6556, Wencote and Stenton Ave., Philadelphia. See: Newark, N.J.																		

1/ Lead and zinc only.
2/ All types material testing.
3/ Structural materials.
4/ Palladium.

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PENNSYLVANIA (Con.)																		
Smith, Rudy & Co., 20 North 3d St. Philadelphia 6.....	X	X	X	X									X					
United States Testing Co., Inc., 601 West Susquehanna Ave., Philadelphia. See: Hoboken, N. J.																		
Pittsburgh Testing Laboratory, 1330 Locust St., Pittsburgh 19..	X	X	X	X	X			X		X	X		X		X	X		
Spectrochemical Laboratories, Inc. 1010 Wood St., Pittsburgh 21....	X	X	X	X				X		X			X		X			1/X
Wayne Laboratories, 17 East Main St., Waynesboro.....	X	X	X	X							X		X		X	X		
Tinius Olsen Testing Machine Co., Easton Rd., Willow Grove.....															X	X		
RHODE ISLAND																		
Brown & Dean Co., 98 Blackstone St., Providence.....					X	X												
Manufacturers' Refining Co., 26 Ship St., Providence 3.....			X		X	X												
Walter M. Saunders, Inc., 184 Whittier Ave., Providence 9.....		X	X	X							X				X	X		
United States Testing Co., Inc., Providence See: Hoboken, N. J.																		
SOUTH DAKOTA																		
Engineering & Mining Experiment Station, South Dakota School of Mines and Technology, Rapid City	X	X	X	X	X	X		X	X	X	X	X			X	X		2/X
TENNESSEE																		
Emerson P. Poste, 309 McCallie Ave. Chattanooga.....	X	X	X	X							X				X			3/X
Barrow Agee Laboratories, Inc., 122 Hernando St., Memphis.....	X	X	X	X									X		X			
United States Testing Co., Inc., 198 So. Main St., Memphis See: Hoboken, N. J.																		
TEXAS																		
Southwestern Laboratories, 2860 Prairie St., Beaumont.....	X	X	X	X						X	X		X		X	X		4/X

1/ Corrosion and microscopic testing.
2/ Concrete and building material.
3/ Concrete, brick and tile.
4/ Construction materials.

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TEXAS (Con.)																		
Southwestern Laboratories, P.O. Box 1654, 2901 West Highway, Big Spring	X	X	X	X						X	X		X		X			1/X
Allied Analytical & Research Laboratories, 3833 Cedar Springs, Dallas 4	X	X	X	X									X					
Pittsburgh Testing Laboratory, 150 Payne St., Dallas 2			X	X	X			X	X	X	X			X			X	2/X
Pope Testing Laboratories, P. O. Box 903, Dallas 1	X	X	X	X									X					
Southwestern Laboratories, 1212 Oak Lawn St., Box 1618, Dallas 1	X	X	X	X							X		X		X	X	X	3/X
Dickinson Laboratories, 1300 West Main St., P.O. Box 1145, El Paso	X	X	X	X	X	X	4/X	X				X	X		X		X	5/X
El Paso Testing Laboratories, P.O. Box 1565, El Paso	X	X	X	X	X	X						X	X		X			
Fort Worth Laboratories, 2900 Cullen St., Fort Worth	X	X	X	X									X		X	X	X	
Southwestern Laboratories, 828 Monroe St., P.O. Box 1379, Fort Worth	X	X	X	X						X	X		X		X	X		6/X
Southwestern Laboratories, 1103 Chartres St., P.O. Box 175, Houston	X	X	X	X						X	X		X		X	X		6/X
UTAH																		
Alonzo F. Bardwell & Co., 158 South West Temple St., Salt Lake City 1	X	X	X		X	X							X					
Black & Deason, 165 South West Temple St., P.O. Box 1888, Salt Lake City 12	X	X	X		X	X		X					X		X	X	X	
Crismon & Nichols, 229 South West Temple St., Box 1708, Salt Lake City 10	X	X			X	X							X					
Deason & Nichols, 160 South West Temple St., Salt Lake City 1	X	X	X		X	X							X					
Galigher Co., Metallurgical Dept., 545 West 8th South St., Salt Lake City 4												X						
Union Assay Office, Inc., 152 South West Temple St., Salt Lake City 10			X	X	X	X							X					

1/ Construction materials.
2/ Oils, paints.
3/ Structural materials.
4/ Manganese, fluorspar.
5/ Concrete work.
6/ Construction materials.

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VIRGINIA																		
Norfolk Testing Laboratories, Inc. 288 Bank St., Norfolk 10.....	X	X	X	X														
Froehling & Robertson, Inc., 814 West Cary St., Richmond.....	X	X	X	X					X	X			X		X	X	X	1/X
WASHINGTON																		
Laucks Testing Laboratories, Inc., 1008 Western Ave., Seattle 4....	X	X	X	X	X	X		X					X					
Metallurgical Laboratory, 5200 Airport Way, Seattle 8.....	X	X	X	X	X	X							X					
W. H. Stowell & Co., 421 Sprague Ave., Spokane.....	X	X			X	X												
Bennetts Chemical Laboratory, Inc., 901 South 9th St., Tacoma 3.....	X	X	X	X	X	X		X				X	X					
Tacoma Assay Office, Lewis E. Jeklin, 517-18 Provident Bldg., Tacoma 2.....	X	X	X	X	X	X		X	X				X		X			2/X
WEST VIRGINIA																		
Commercial Testing & Engineering Co., 626 Broad St., Charleston..	X	X										X	X		X		X	3/X
WISCONSIN																		
Bjorksten Research Laboratories, Inc., 323 West Gorham St., Madison 3.....									X			X						
Anderson Laboratories, 3920 West National Ave., Milwaukee 15.....			X	X							X		X		X			4/X
T. H. Cochrane Laboratories, 729 South 16th St., Milwaukee 4.....		X	X	X							X		X		X	X		
Orthmann Laboratories, Inc., 922 North 4th St., Milwaukee 3.....	X		X															
Sommer Chemical Laboratories, Inc., 152 West Wisconsin Ave., Milwaukee 3.....		X																
WYOMING																		
Chemical & Geological Laboratories, 521 South Center, Casper.....	X	X																
ALASKA																		
Territorial Department of Mines Offices at:																		
Anchorage.....	X	X	X	X	X													
College.....	X	X	X	X	X													
Ketchikan.....	X	X	X	X	X													
Nome.....	X	X	X	X	X													

1/ Structural materials.
2/ Concrete.
3/ Cement and concrete.
4/ Fuel oil and coke.

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CANADA																		
E. W. Widdowson & Co., 305 Josephine St., Box 610, Nelson, British Columbia	X	X	X	X	X	X		X				X	X					
G. S. Eldridge & Co., 633 Hornby St., Vancouver 1, British Columbia	X	X	X	X	X	X		X			X	X	X		X			1/X
MacDonald & MacDonald, Ltd., 718 Granville St., Vancouver 2, British Columbia			X	X											X	X	X	
Hersey Laboratories, Ltd., 233 Fort St., Winnipeg, Manitoba	X	X	X	X	X	X		X	X			X	X		X	X		2/X
Bell-White Laboratories, Ltd., Haileybury, Ontario	X	X	X	X	X	X	3/X											
Johnson, Matthey & Mallory, Ltd., 110 Industry St., Toronto 15, Ontario					X	X												
Ontario Research Foundation, 43 Queen's Park, Toronto 5, Ontario	X	X	X	X					X	X	X	X	X		X	X	X	4/X
Toronto Testing Laboratories, Ltd., 73 Adelaide St., West, Toronto, Ontario	X	X	X	X	X	X		X							X	X		
Swastika Laboratories, Ltd., P.O., Drawer 5-A, Swastika, Ontario	X	X			X	X			X				X					
Canadian Bronze Co., Ltd., 999 Delorimier Ave., Montreal 24, Quebec		X	X	X							X		X		X	X		
J. T. Donald & Co., Ltd., 1181 Guy St., Montreal, Quebec	X	X	X	X	X	X							X		X	X	X	
Milton Hersey Co., Ltd., 980 St. Antoine St., Montreal, Quebec	X	X	X	X									X		X	X		5/X
Mines Laboratories, Annex E. Parliament Buildings, Quebec City, Quebec	X	X	X	X														
Assayers, Ltd., 183 Gamble St., West, Rouyn, Quebec	X	X	X	X	X	X							X					

1/ Tensile tests.
2/ Chemical uranium determination.
3/ Uranium, chemical and radiometric.
4/ Plastics.
5/ Concrete, cement, asphalt and aggregates.

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